Distribution and habitat of the Holiday darter in Shoal Creek, Talladega National Forest, Alabama

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June 2002

The recently described Holiday darter (*Etheostoma brevisrostrum*) has a fragmented and limited distribution, and may represent a species complex comprised of at least two species, one of which is restricted to Alabama. A recent status survey indicates that the Alabama Holiday darter has been extirpated from three of the five historical localities, and is now completely restricted to Shoal Creek between Whiteside and Sweetwater lakes. This reach of Shoal Creek lies entirely on the Talladega National Forest.

The distribution of the Holiday darter in Shoal Creek is fragmented by Highrock Lake, a small impoundment that effectively blocks movement of the species and creates two subpopulations. It is possible that this barrier prevents gene flow between the two subpopulations. The isolation of these two populations and limited potential for recolonization of either stream section makes the species especially vulnerable to extinction, as smaller areas of habitat typically support smaller populations, which may not be capable of sustaining themselves. Viable populations are large enough to sustain themselves through successful reproduction (recruitment) over time. Since holiday darters are largely restricted to riffle mesohabitats, it is also important that such patches are connected so that all available habitat is accessible to the species. In this case, connectivity may mean that patches are within the range of movement for this species. If the two subpopulations are not considered viable on their own, creation of a dispersal corridor through Highrock Lake may become a necessary management option for protection of this species.

The objectives of this proposed research were to investigate Holiday darter population viability by: 1)assessment of population densities within the two

subpopulations; 2)determination of population structure (lengths, sex ratio); 3)investigation of connectivity of habitat patches within each stream section.

Fishes were sampled in early spring and late summer via seine. Each fish was sexed and measured (standard length, mm). Each habitat unit was measured (length, and mean width). Density of Holiday darters in each sampling unit was determined as number per unit area. Distance between suitable habitat patches was measured (meters). In order to investigate movement in this species, a small number of adjacent habitat patches was chosen for monitoring. Darters in each patch were captured, marked by fin clipping and released. Subsequent monitoring included these study patches plus patches 0.5 mi. up- and downstream of the study area.

Results and discussion

Seventeen sites were sampled for holiday darters including eleven sites on Forest Service land (Figure 1, Appendix). Fishes were sampled by seining all available microhabitats. Samples from riffle and Pool habitat units were kept separate at four on-forest sites (Tables 1-4). Physical habitat measurements (water depth and velocity, dominant and subdominant substrate type) were taken for three – five transects per habitat unit (available habitat), and focal habitat measurements were taken where Holiday darters were collected (Tables 7-8). The length (m) and average width (3 measurements) of each habitat unit was also measured. Water velocity was measured using a Marsh-McBirney flow meter.

One voucher specimen of Holiday darter was taken; all other specimens of Holiday darters were released. Other fish samples were euthanitized with MS 222, preserved in 10% formalin, stored in 70% ethanol and vouchered in the Auburn University Fish collection.

Holiday darters were collected at sites 1, 3, 4, and 15 – 17 (Tables 1-6), all of which lie on National Forest land and are in Shoal Creek proper (Figure 1). Holiday darters were not found at site 2, although they were historically known from this location (Suttkus and Etnier 1991) and were also not found at the other sites surveyed (Tables 1-6).

Holiday darters were only found in riffles during this survey. When available habitat is compared to focal habitat (where darters were collected) within these units, Holiday darters seemed to prefer shallower water with moderate to swift flows (Figures 2-3, Tables 7-8). They also prefer cobble substrate, and even within riffles are less common in areas with bedrock, boulder or gravel substrate. A Principal Component Analysis of habitat data and darter number also suggests this relationship (Table 9). The first three components explained 91% of the variance and a scree plot indicated retention of three components. The first component ordinates large riffle size (m^2) with high darter number and high water velocity with relatively small substrate size (e.g., cobble). The second component ordinates large substrate size with large riffles, and the third component suggests a relationship between greater water depth and lower water velocity, with higher numbers of darters in shallower water.

From this survey, it appears that the Alabama form of the Holiday darter is restricted to approximately 4 miles of Shoal Creek proper, within the Talladega National

Forest. Unfortunately, the distribution of the species is bisected by Highrock Lake, a small reservoir on Shoal Creek. The reservoir is possibly a distributional barrier for the species, but evidence of this is lacking at this time.

Literature Cited

Suttkus, R. D., and D. A. Etnier. 1991. *Etheostoma tallapoosae* and *E. brevirostrum*, two new darters, subgenus *Ulocentra*, from the Alabama River drainage. Tulane Studies in Zoology and Botany 28:1-24.

Lists of fishes collected during holiday darter status survey. One holiday darter specimen (indicated in table) was vouchered in the AUM collection; all others were released.

Table 1. List of species and number of specimens for each habitat type from Shoal Creek, at Pine Glenn Recreation Area, Site 1. Site locality listed in Appendix.

	Pool 1	Riffle 1	Pool 2	Riffle 2	Pool 3	Riffle 3
Cyprinella callistia	2	20	2	13	3	1
Cyprinella trichroistia	15	4	20	9	21	5
Notropis asperifrons	7	0	0	0	6	0
Notropis xaenocephalus	12	6	0	11	24	0
Hypentelium etowanum	1	0	0	0	2	0
Cottus carolinae	0	0	0	1	0	1
Lepomis macrochirus	3	0	2	0	1	0
Lepomis megalotis	1	0	0	0	0	0
Lepomis microlophus	3	0	2	0	0	0
Micropterus coosae	3	0	1	0	1	0
Pomoxis annularis	1	0	0	0	0	0
Etheostoma brevirostrum	**0**	**1**	**0**	**2**	**0**	**0**
Etheostoma coosae	0	0	0	1	0	2
Etheostoma jordani	0	2	0	1	0	2
Etheostoma whipplei	0	0	0	0	1	0
Percina nigrofasciata	0	0	0	1	0	2
Percina palmaris	0	0	0	2	0	1
Percina kathae	0	0	0	0	0	0

Table 2. List of species and number of specimens for each habitat type from Little Shoal Creek, Site 2. Site locality listed in Appendix.

	Riffle 1	Pool 1	Riffle 2	Pool 2	Riffle 3	Pool 3
Cyprinella callistia	0	7	1	0	0	1
Cyprinella trichriostia	2	15	4	10	4	17
Notropis stilbius	0	0	0	1	0	2
Notropis xaenocephalus	0	3	0	3	3	2
Semotilus atromaculatus	0	0	0	1	0	0
Hypentelium etowanum	0	2	0	0	0	1
Fundulus stellifer	0	0	1	2	0	0
Cottus carolinae	2	2	0	1	5	1
Lepomis gulosus	0	1	0	0	0	0
Lepomis macrochirus	0	0	0	1	0	0
Lepomis megalotis	0	2	0	1	1	0
Lepomis microlophus	0	0	0	1	0	0
Micropterus coosae	0	0	0	1	0	2
Etheostoma coosae	0	0	0	0	1	0
Percina nigrofasciata	0	2	0	0	0	1

Table 3. List of species and number of specimens for each habitat type from Shoal Creek, above Highrock Lake, Site 3. Site locality listed in Appendix.

	Pool 1	Riffle 1	Pool 2	Riffle 2	Pool 3	Riffle 3
Cyprinella callistia	0	6	0	16	0	11
Cyprinella trichroistia	33	9	19	8	30	0
Notropis stilbius	13	0	0	0	0	0
Notropis xaenocephalus	5	1	1	0	1	0
Hypentelium etowanum	0	0	0	2	1	0
Cottus carolinae	0	0	0	1	0	1
Etheostoma brevirostrum	**0**	**2**	**0**	**8**	**0**	**6**
Etheostoma jordani	0	5	0	2	0	1
Percina palmaris	0	2	0	2	0	1

Table 4. List of species and number of specimens for each habitat type from Shoal Creek, below Highrock Lake, Site 4. Site locality listed in Appendix.

	Pool 1	Riffle 1	Pool 2	Riffle 2	Pool 3	Riffle 3
Campostoma oligolepis	0	2	0	0	0	0
Cyprinella callistia	10	3	0	1	5	2
Cyprinella trichroistia	18	13	26	10	27	26
Cyprinella venusta	0	0	0	9	0	0
Notropis xaenocephalus	0	0	11	0	13	0
Notropis volucellus	1	0	0	0	0	0
Hypentelium etowanum	0	1	0	1	0	0
Noturus leptacanthus	0	0	0	0	0	1
Cottus carolinae	0	2	0	5	0	1
Lepomis macrochirus	0	0	1	0	0	0
Lepomis megalotis	0	0	0	0	1	0
Micropterus punctulatus	0	0	0	0	1	0
Etheostoma brevirostrum	**0**	**10**	**0**	**14**	**0**	**17**
Etheostoma coosae	0	0	0	2	0	1
Etheostoma jordani	0	0	0	2	0	0
Percina nigrofasciata	0	0	0	1	0	0
Percina palmaris	1	1	0	5	0	1

Table 5. List of species and number of specimens collected from sites off National Forest land or not separated by habitat type. Site localities listed in Appendix.

	Site 5	Site 6	Site 7	Site 8	Site 9
Campostoma oligolepis	0	1	2	4	1
Cyprinella caerulea	0	0	1	0	0
Cyprinella callistia	1	3	1	0	4
Cyprinella trichroistia	0	1	15	17	0
Cyprinella venusta	3	0	0	0	0
Notropis stilbius	0	0	1	0	0
Phenocobius catostomus	0	1	0	0	0
Semotilus atromaculatus	0	0	0	4	0
Hypentelium etowanum	0	0	5	0	0
Moxostoma duquesnei	0	0	1	0	0
Fundulus stellifer	3	0	0	0	0
Cottus carolinae	0	1	2	0	0
Lepomis macrochirus	0	0	0	0	1
Lepomis megalotis	1	0	0	0	0
Lepomis microlophus	0	0	0	0	1
Micropterus punctulatus	1	0	1	0	0
Etheostoma jordani	0	1	0	0	0
Etheostoma stigmaeum	0	0	3	2	0
Percina nigrofasciata	0	0	1	1	1

Table 6. List of species and number of specimens collected off National Forest Land or not separated by habitat type. Site localities listed in Appendix. Fishes not vouchered from sites 15 and 16; p = present.

	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17
Campostoma oligolepis	0	2	0	0	3	0	0	0
Cyprinella callistia	0	3	5	0	1	p	p	p
Cyprinella trichroistia	7	14	3	0	16	p	p	p
Luxilus chrysocephalus	0	0	0	0	4	0	0	0
Notropis stilbius	0	0	1	0	4	0	0	p
Notropis xaenocephalus	1	5	2	0	0	0	0	0
Rhinichthys atratulus	0	0	0	3	0	0	0	0
Semotilus atromaculatus	0	0	0	3	0	0	0	0
Hypentelium etowanum	0	1	0	0	2	p	p	p
Moxostoma duquesnei	0	0	0	0	1	0	0	0
Cottus carolinae	0	2	0	0	1	0	p	0
Lepomis cyanellus	0	0	0	0	1	0	0	0
Lepomis macrochirus	0	0	2	0	0	0	0	0
Lepomis megalotis	1	6	0	0	4	p	0	0
Lepomis microlophus	0	0	7	0	0	0	0	0
Micropterus coosae	1	0	0	0	1	0	0	p
Micropterus punctulatus	0	0	1	0	2	0	0	0
Etheostoma brevirostrum	**0**	**0**	**0**	**0**	**0**	**29**	**3**	**57**
Etheostoma coosae	0	8	3	3	1	0	p	p
Etheostoma jordani	0	2	2	0	1	0	p	p
Percina palmaris	0	0	5	0	0	p	p	p

Table 7. Summary of physical habitat data for transects (mean plus standard deviation in parenthesis). n = 9 measurements per habitat unit.

	Site 1		Site 2		Site 3		Site 4	
	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle
Depth, cm	69.3	39.1	27.6	14.5	40.0	11.3	30.6	13.4
	(16.2)	(16.4)	(11.5)	(7.1)	(23.0)	(2.6)	(10.7)	(3.3)
Flow, m/sec.	0.10	0.33	0.14	0.35	0.03	0.35	0.10	0.35
	(0.11)	(0.26)	(0.10)	(0.20)	(0.02)	(0.15)	(0.06)	(0.12)
Substrate	gravel	gravel	gravel	gravel	gravel	cobble	gravel	gravel

Table 8. Summary of focal habitat. (mean plus standard deviation in parenthesis).

	Site 1 n = 3	Site 3 n = 16	Site 4 n = 41
Depth, cm	36.0	12.3	13.4
	(0.0)	(2.9)	(3.2)
Flow, m./sec.	0.6	0.38	0.35
	(0.08)	(0.18)	(013)
Substrate	cobble	cobble	cobble

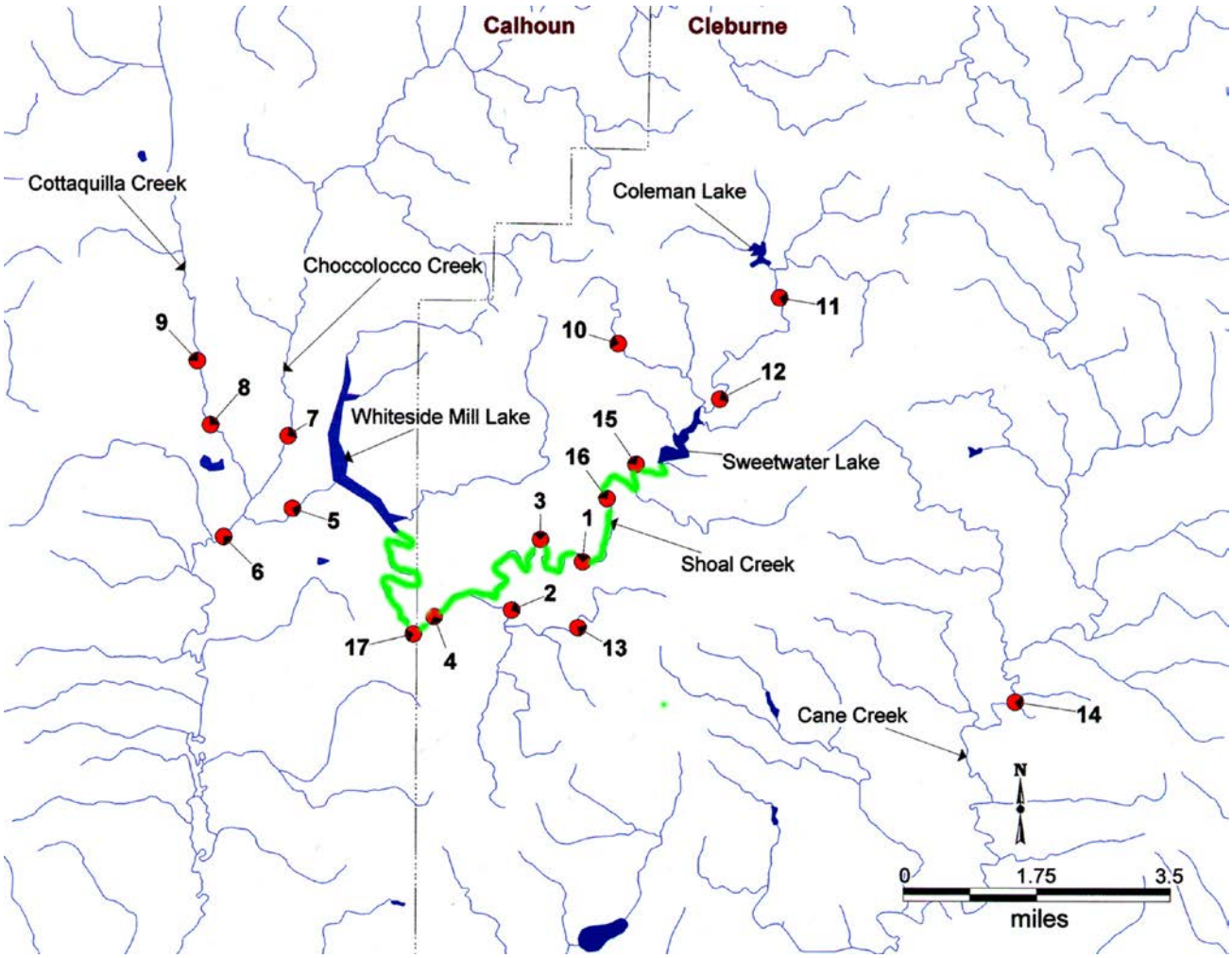
Table 9. Variable loadings on three principal component axes. Percent variance explained by each component is given in parentheses. Substrate sizes were categorized with the smallest size = 1 (sand) and the largest = 5 (bedrock).

	Component		
Variable	1 (44%)	2 (26%)	3 (21%)
Riffle size, m2	.669	.686	-.0006
Darter number	.852	.278	.304
Depth	-.124	.311	.917
Velocity	.793	.153	-.437
Dominant substrate size	-.473	.752	-.381
Subdominant substrate size	-.758	.559	-.028

Figure 1. Localities sampled for Holiday darters. Numbers correspond to Appendix. Shaded area includes known range of Holiday darters.

Figure 2. Frequency of depths occupied by Holiday darters (focal habitat) compared to habitat in riffle habitat units (available habitat).

Figure 3. Frequency of water velocities occupied by Holiday darters (focal habitat) compared to habitat in riffle habitat units (available habitat).



Appendix: Sampling localities

1. Shoal Creek, Pine Glenn Recreation Area, 8.1 mi. N Hwy 78, Cleburne Co., AL Forest Road 531
   4 May 2000, 6 June 2001

2. Little Shoal Creek, Forest Road 531, 1 mi. E Cleburne Co. Line, Cleburne Co., AL, 33˚49'48" N, 85˚37'07" W
   18 May 2000

3. Shoal Creek, 5 mi. N Heflin, 1 mi. downstream from Pine Glenn Recreation Area, Cleburne Co., AL, 33˚43.336 N, 85˚36.560 W
   6 July 2000, 7 June 2001, 22 June 2001, 7 July 2001

4. Shoal Creek, off Forest Road 531, below Highrock Lake, near Cleburne-Calhoun County Line, Cleburne Co., AL, 33˚42.872 N, 85˚37.907 W
   6 July 2000, 23 June 2001

5. Shoal creek, 2.3 mi. SE White Plains, below Whitesides Mill Lake, Calhoun Co., AL, 33˚44'15" N, 85˚39'37" W
   18 May 2000

6. Choccolocco Creek, 1mi. S White Plains at Hwy 9, Calhoun Co., AL
   33˚43.772 N, 85˚ 40.777 W
   7 July 2000

7. Choccolocco Creek, 2 mi. SE White Plains, unnamed county road, Calhoun Co., AL, 33˚44.600 N, 85˚40.173 W
   7 July 2000

8. Cottaquilla Creek, 0.2 mi. E White Plains, unnamed road, Calhoun Co., AL
   33˚45'19" N, 85˚41'09" W
   27 July 2000

9. Cottaquilla Creek, 0.5 mi. SE White Plains, Calhoun Co., Al
   33˚44'39" N, 85˚40'47" W
   27 July 2000

10. trib. to Shoal Creek, Forest Road 500, 7 mi. N Heflin, Cleburne Co., AL
    33˚45'45" N, 85˚35'26" W
    27 July 2000

11. Shoal Creek, Forest Road 553, 7 mi. N Heflin, Cleburne Co., AL
    33˚46'13" N, 85˚33'27" W

27 July 2000

12. Shoal Creek, Forest Road 546, above Sweetwater Lake, Cleburne Co., AL
33˚45'12" N, 85˚34'25" W
27 July 2000

13. trib. to Shoal Creek, Forest Road 500, 4 mi. N Heflin, Cleburne Co., AL
33˚42'35" N, 85˚35'38" W
27 July 2000

14. Cane Creek, 3 mi. E Heflin, County road 27, Cleburne Co., AL
33˚39'34" N, 85˚30'57" W
27 July 2000

15. Shoal Creek, 1.5 mi. upstream from Pine Glen Campground, 6.5 mi. N Heflin, Cleburne Co., AL
7 June 2001

16. Shoal Creek, 0.5 mi. downstream from Sweetwater Lake,
33˚44'37" N, 85˚34'56" W
8 June 2001

17. Shoal Creek, 0.5 mi. from end of FS rd. 530
33˚42'92" N, 85˚38'26" W
Cleburne/Calhoun Co. line, AL
23 June 2001